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Collette et al.

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[54] **INJECTION MOLDED PREFORM, METHOD OF TREATING SAME AND CONTAINER FORMED THEREFROM**

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[52] **U.S. Cl.:** 215/31; 215/1 C; 264/25; 264/235; 264/346; 264/521; 264/532; 264/535; 428/357; 428/36.92; 428/542.8

[58] **Field of Search:** 215/1 C, 31; 428/35.7, 428/36.6, 36.7, 36.92, 542.8; 264/25, 235, 346, 520, 521, 532, 535

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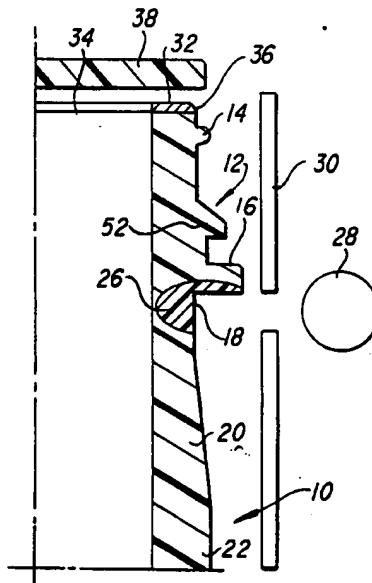
Primary Examiner—Sue A. Weaver

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[57] **ABSTRACT**

A polyester preform which is injection molded preferably of PET and wherein the preform is provided with a molded neck finish or neck portion including threads which are molded to a high tolerance and wherein the neck finish may receive a closure cap of the type having a tamper indicating band which engages over a retaining bead also molded to a high tolerance as part of the neck finish. In order to maintain the container which is blow molded from the preform in axial alignment with the neck finish and thus eliminate the perpendicularity problem, a ring of the preform immediately below the flange which functions as the capping ring, is heated to a high temperature and crystallized. In a like manner, the end sealing surface is also heated to a high temperature and crystallized. The remainder of the neck finish remains in its amorphous state without disturbing the configuration of either the threads or the retaining bead. This combination of crystallized portions with the remainder of the neck finish remaining amorphous assures a high quality connection between a closure cap, whether the closure cap is formed of plastic or metal, while providing the end sealing surface with a hard tough finish resisting deformation and at the same time reducing the closure cap removal torque.

19 Claims, 1 Drawing Sheet



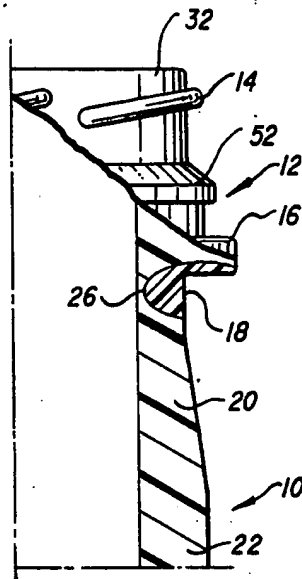


FIG. 1

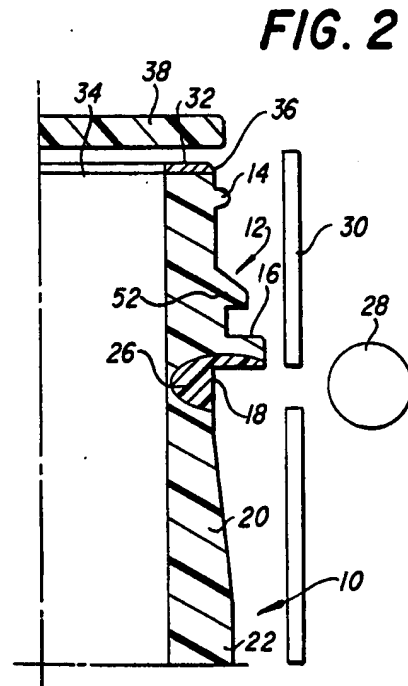


FIG. 2

FIG. 3

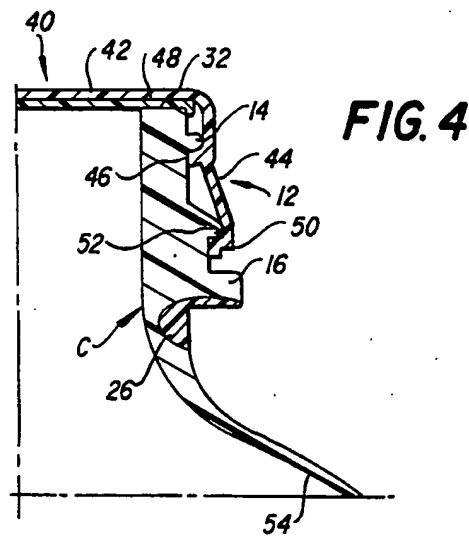
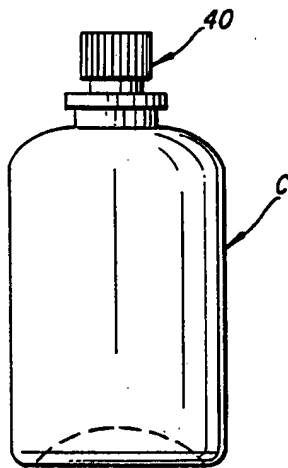


FIG. 4

INJECTION MOLDED PREFORM, METHOD OF TREATING SAME AND CONTAINER FORMED THEREFROM

This invention in general relates to new and useful improvements to injection molded preforms from which containers are blow molded, and more particularly to a preform which is provided with a molded neck portion including threads for receiving a closure cap and the crystallization of only certain parts of the neck portion for beneficial effects.

In the customary reheat blow molded polyester (PET) container, the neck portion or neck finish and an annular part of the resultant container immediately below the customary capping flange of the neck portion are unoriented. Then there is a rapid orientation transition in a shoulder portion with there being a maximum biaxial orientation in a body of the container. Such containers for hot fill applications are normally blow molded within heated molds having a temperature at the completion of the blow molding operation which is greater than the glass temperature of the particular polyester resin from which the container is formed. This orientation and thermal conditioning process increases the relative Tg of the oriented regions to a level substantially above that of the unoriented amorphous regions. As a result of the high mold temperature and the low Tg of the unoriented polyester resin, the unoriented annular part immediately below the capping flange shrinks upon mold opening to excess with a resulting tilting of the neck portion relative to the container body.

In accordance with the teaching of Ota et al U.S. Pat. No. 4,572,811 granted Feb. 25, 1986, it is taught that one may crystallize a preform wholly from the periphery in the center of its bottom. The Ota et al patent also teaches that one may either crystallize the entire neck portion of the blow molded container or may provide the container with a special neck end which is the only crystallized part of the neck portion. On the other hand, Hayashi et al U.S. Pat. No. 4,589,559 granted May 20, 1986 teaches that the entire neck portion of a polyester preform to be blow molded into a container is to be crystallized.

The crystallization of a polyester resin (PET) results in the resin being made more dense with the resultant shrinkage. Further, the shrinkage is not uniform. The net result is that when one crystallizes the neck portion of a polyester resin preform, threads of such neck portion, which are molded with a very high precision, become distorted and somewhat defective. Further, when the neck portion is provided with interrupted threads and a retaining bead, the control as to dimensional accuracy required to receive a plastic tamper band indicating closure cap is hampered.

In view of the foregoing, it will be readily apparent that it is undesired to follow the teaching of the prior art to crystallize the entire neck portion of either a blow molded polyester container or an injection molded preform.

There has been concurrently developed a polyester (PET) preform wherein crystallization is restricted to a ring immediately below the capping flange and above the shoulder forming portion of the preform. This is the subject of a commonly assigned pending application.

It has been found that while the crystallization of a ring portion of the polyester preform immediately

below the capping flange does maintain axial alignment of the blow molded container body with the neck portion, the amorphous neck portion still has certain deficiencies. This is particularly true when the resulting container is to receive a screw threaded metal closure cap of the type having lugs for engaging multiple threads on the container or a plastic closure with a tamper indicating band for engagement beneath a retaining bead.

In accordance with this invention, in addition to crystallizing a ring of the preform immediately below the capping flange, the end sealing surface is also crystallized to a relatively small depth.

With the above and other objects in view that will hereinafter appear, the nature of the invention will be more clearly understood by reference to the following detailed description, the appended claims, and the several views illustrated in the accompanying drawings.

FIG. 1 is a fragmentary half sectional view of an upper part of a preform formed in accordance with this invention with portions shown in elevation.

FIG. 2 is a half sectional view of the preform of FIG. 1 and shows the manner in which limited areas of the preform are crystallized.

FIG. 3 is a fragmentary elevational view of a filled and closed container blow molded from the preform of FIG. 1.

FIG. 4 is an enlarged fragmentary sectional view taken through the neck portion of the container of FIG. 3 and shows the details of a plastic closure cap thereon.

Referring now to the drawings in detail, it will be seen that there is illustrated in FIG. 1 an upper portion of a conventional preform formed in accordance with this invention. The preform, which is identified by the numeral 10, is injection molded of a saturated polyester, preferably polyethylene terephthalate (PET) with the preform 10 being of a conventional configuration.

The preform 10 includes an upper neck portion or neck finish 12 which is generally provided with thread means 14 for receiving a closure cap and which includes a lower annular flange 16 which is generally known in the trade as a capping flange or capping ring.

Immediately below the flange 16, the preform 10 is provided with a short cylindrical portion 18 which, in the heating of the preform prior to the blow molding of the preform in a blow mold to form a container, is not heated to an orientation temperature. Below this short cylindrical portion 18 the thickness of the preform 10 gradually increases in what is described as a shoulder forming portion 20. Below the shoulder forming portion 20, the preform becomes generally of a constant thickness and becomes a body forming portion 22. The above discussed axial alignment or perpendicularity problem lies in the portion 18. It is this portion of the preform 10 which is clamped in a blow mold during the inflation of the preform 10 to form a container such as the container C shown in FIG. 3.

Referring once again to FIG. 1, it will be seen that there is illustrated a shaded area at the top of the cylindrical portion 18 which defines a thermally crystallized ring or annular part 26. The crystallinity is preferably between 30 and 45% with the result that the plastic material preform 10 in this area is more dense and the glass temperature is greatly increased.

As is clearly shown in FIG. 2, it will be seen that the thermally crystallized ring 26 is formed by rotating the preform 10 about its axis while it passes along a quartz infrared heater 28. A mask 30 is positioned between the

heater 28 and the preform 10 so as to restrict the area which is heated and thus crystallized. While it is preferred that the ring 26 be restricted to the cylindrical portion 18, the heating and thus crystallization may extend into the underside of the flange 16 as is clearly shown in the drawings.

While the thermally crystallized ring 26 has been found to solve the problem of perpendicularity, it has been found that other improvements in the preform 10 are desired. Most specifically, it is additionally desired that an end sealing surface 32, which as is best shown in FIG. 2, defines an open end or mouth 34, be of an increased density and thus hardened. Therefore, the end sealing surface 32 is also heated and crystallized as at 36.

The crystallization of the end sealing surface portion 36 is effected by moving the rotating preform beneath a flat heater strip 38. The strip heater 38 is maintained at the temperature of 700°-800° F. and is placed 1.0-2.0 mm above the path of the end sealing surface 32.

The strip heater 38 is of a length along the path of the preform 10 such that the end sealing surface 32 is heated for a period of time ranging from 15 to 25 seconds depending upon the PET co-polyester content, the IV of the polyester and the width of the end sealing surface. The result is a crystallized end sealing surface (ESS) to a depth of 0.5-1.0 mm. The resulting percent crystallization of the ESS is 30-45% as compared to the non-treated amorphous adjacent regions of the end portion of 5-10%.

It is also to be understood that the ESS surface temperature during crystallization rises to 350±50° F. which is the maximum crystallization rate temperature for PET.

From the foregoing, it will be seen that the restricted crystallization of the upper part of the preform 10 in the areas 26 and 36 provide all of the desired advantages obtained by the overall crystallization of the upper part of the preform 10 while at the same time eliminating all of the undesirable features of crystallizing the entire neck portion 12. Thus the threads 14 retain the high tolerance dimensions as molded.

At this time it is pointed out that the crystallization of the PET increases the modulus (i.e. hardness), thus increasing its resistance to impact damage. This is highly desirable with respect to the end sealing surface 32 in that it will substantially increase the life of a returnable/refillable PET bottle which requires a non-damaged end sealing surface to permit proper cap application without CO₂ leakage.

With respect to the foregoing, 10 bottles each were prepared with amorphous end sealing surfaces and crystallized end sealing surfaces (1.5 liter refillable at 100 grams. With a 28 mm beverage finish). These bottles, which were filled with carbonate water at four volumes and closed with a conventional ALCOA closing machine with aluminum ALCOA closures and inspected for leakers after 24 hours at 100° F. were dropped first from varying heights onto a concrete floor of average roughness. The results are as follows:

Drop Hgt Ft	% Leakers	
	Amorphous	Crystallized
Control	-0-	-0-
2	10	-0-
4	40	-0-
6	90	10

The crystallization of the end sealing surfaces 32 also had a definite advantage over amorphous end sealing surfaces in that less torque was required to open such containers which were closed with polypropylene compounded screw threaded closures. In this test 43 mm polypropylene closures were applied at a temperature of 170° F. to both the amorphous and crystallized end sealing surface molded finish to a 15 inch-lbs. torque. After the containers were refrigerated at 45° F., the closures were removed and the opening torques recorded as follows for 20 samples of each type of container:

	Control Amorphous	Crystallized ESS
In-Lbs	28	23.5
Range	18-40	14-30

It has been further found that amorphous finishes do not permit the use of rigid metal closures for hot fillable PET bottle applications. The crystallized end sealing surface 32 when used in conjunction with a crystallized band 26 below the capping flange 16 permits the use of conventional metal lug or intermediate contact closure caps by maintaining the finished dimensions and opening torques after hot filling and cooling by preventing distortion in the form of ovality which reduces thread to lug contact yielding low opening torques. For example, if the thread means 14 are in the form of multiple start threads, for example four threads, and a closure cap is provided with a similar number of lugs, when the closure cap is torqued onto the neck finish, there is a tendency for the neck finish to assume a generally square cross section as opposed to the circular cross section. This greatly reduces the contact between the individual threads and the closure cap lugs. Thus if the end portion 12 is not provided with the crystallized end sealing surface 32 and the thread means 14 are permitted to remain in their amorphous state, it is not commercially feasible to apply rigid metal closure caps of the lug or intermittent contact type to the PET neck finish. On the other hand, if the entire neck portion is crystallized, then the thread means 14 will distort to the extent that proper contact between the closure cap lugs and the multiple thread starts 14 is not optimum.

Most specifically, with reference to FIGS. 3 and 4, it will be seen that the container or bottle C is closed by means of a metal closure cap 40. The metal closure cap 40 is of a conventional type and includes an end panel 42 and a depending skirt 44. The skirt 44 carries a plurality of circumferentially spaced lugs 46, one for each of the multiple thread starts 14. The lugs 46 are engaged beneath the thread starts 14 and serve to tightly clamp the ring gasket 48 carried by the closure cap 40 against the end sealing surface 32.

Further, the skirt 44 terminates in a tamper indicating band 50 which locks beneath a retaining bead 52. The retaining bead 52 is part of the neck finish of the container and is incorporated in the preform as is clearly shown in FIGS. 1 and 2.

At this time it is pointed out that the dimensions of the retaining bead 52 are also critical in that the tamper indicating band 50 must snap over and below the retaining bead 52. If the retaining bead 52 is not cylindrical in outline, but loses its cylindrical configuration, or if the average bead diameter varies in excess of $X \pm 0.005$

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inches, the tamper indicating band 50 cannot properly co-act with the bead 52. This is most critical.

It is to be noted that in the formation of the container C, the shoulder forming portion 20 is radially expanded and thinned to form the shoulder 54 of the container.

While the crystallized ring 26 and the crystallized end sealing surface 32, together with the amorphous remainder of the neck portion 12 are most beneficial when the thread means 14 are of the multiple start or interrupted type for use with a metal closure having lugs, it is to be understood that, as will be readily apparent from the foregoing, these crystallized areas will also be beneficial in conjunction with thread means of the screw thread type for receiving a plastic closure cap in threaded relation.

Although only a preferred embodiment of the preform treatment and the resultant container formed from the preform by blow molding have been specifically illustrated and described herein, it is to be understood that minor variations may be made in the treatment of the preform and the resultant preform and container without departing from the spirit and scope of the invention as defined by the appended claims.

We claim:

1. A plastic preform for forming a hollow blow molded plastic container, said preform being of an injection molded construction and including a neck finish, said neck finish terminating at a free end in an end sealing surface and having remote from said end sealing surface a lower flange with there being high tolerance molded threads between said end sealing surface and said flange, said preform also including a container shoulder forming portion next to said flange remote from said threads, and a body forming portion, a part of said shoulder forming portion being a crystallized part and of a greater strength than adjacent parts of said preform, said preform being further improved by said end sealing surface being also crystallized, and said threads being free of added crystallization with said threads remaining as formed.

2. A preform according to claim 1 wherein the crystallization of said end sealing surface is to a depth on the order of 0.5 to 1.0 mm.

3. A preform according to claim 1 wherein the percent of crystallinity of said end sealing surface is on the order of 30-45% as compared to 5-10% for the threads.

4. A preform according to claim 1 wherein said threads are interrupted.

5. A preform according to claim 1 wherein said threads are separate threads for engagement by closure lugs.

6. A preform according to claim 1 wherein said plastic is a polyester.

7. A preform according to claim 1 wherein said plastic is PET.

8. A method of improving a plastic preform of the injection molded type having a neck finish including an

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end sealing surface, high tolerance external thread means, and a capping flange, said method comprising the steps of separately heating said end sealing surface and an annular region closely below but spaced from said capping flange to a high crystallization temperature while maintaining said preform between said crystallized end sealing surface and said crystallized annular region untreated whereby said end sealing surface becomes dense and exhibits a lowered friction co-efficient while said thread means maintain their as molded high tolerance.

9. A method according to claim 8 wherein said end sealing surface is heated to a temperature of $350^{\circ} \pm 50^{\circ}$ F.

10. A method according to claim 8 wherein said end sealing surface is heated to a temperature of $350^{\circ} \pm 50^{\circ}$ F. for a period of 15-25 seconds.

11. A method according to claim 8 wherein said end sealing surface is heated to a temperature of $350^{\circ} \pm 50^{\circ}$ F. for a period of 15-25 seconds, and crystallized to a depth of 0.5-1.0 mm.

12. A method according to claim 8 wherein said end sealing surface is heated to a temperature of $350^{\circ} \pm 50^{\circ}$ F. by passing the end sealing surface 1.0-2.0 mm below a flat strip heater maintained at a temperature on the order of 700° - 800° F.

13. A blow molded plastic container comprising a neck portion, a shoulder portion leading from said neck portion to a tubular body, and said tubular body being closed by a bottom portion, a crystallized ring portion between said neck portion and said shoulder portion maintaining axial alignment of said tubular body with said neck portion, said neck portion having an open end defined by a crystallized end sealing surface and said neck portion between said crystallized end sealing surface and said crystallized ring portion being a non-treated amorphous region and including thread means for receiving a closure.

14. A container according to claim 13 wherein said crystallized end sealing surface is crystallized for a depth of 0.5 to 1.0 mm.

15. A container according to claim 13 wherein said crystallized end sealing surface is crystallized for a depth of 0.5 to 1.0 mm at a crystallinity of 30-45%.

16. A container according to claim 13 wherein there is a closure tamper band retaining bead below said thread means.

17. A container according to claim 13 wherein said thread means are in the form of a multiple start thread arrangement.

18. A container according to claim 17 wherein said container is closed by a metal closure cap having plural lugs engaging said multiple start thread arrangement.

19. A container according to claim 17 wherein there is a closure tamper band retaining bead below said thread means.

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United States Patent [19]
Tsukada et al.

[11] **Patent Number:** 4,591,060
[45] **Date of Patent:** May 27, 1986

[54] **CONTAINER OF POLYETHYLENE
TEREPHTHALATE OR SATURATED
POLYESTER RESIN**

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[21] **Appl. No.:** 592,747
[22] **Filed:** Mar. 23, 1984

Related U.S. Application Data

- [63] Continuation of Ser. No. 331,872, Dec. 17, 1981, aban-
doned.

[30] **Foreign Application Priority Data**

- Jan. 29, 1981 [JP] Japan 56-11949[U]
[51] **Int. Cl.⁴** B65D 23/00; B29C 35/00
[52] **U.S. Cl.** 215/1 C; 215/31
[58] **Field of Search** 215/1 C, 31, 324;
264/521, 25, 235, 520, 532, 537

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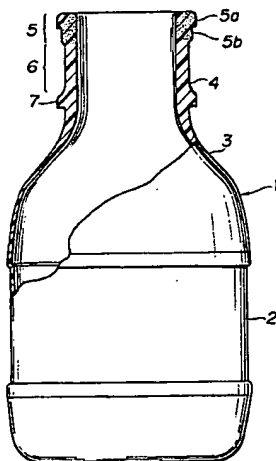
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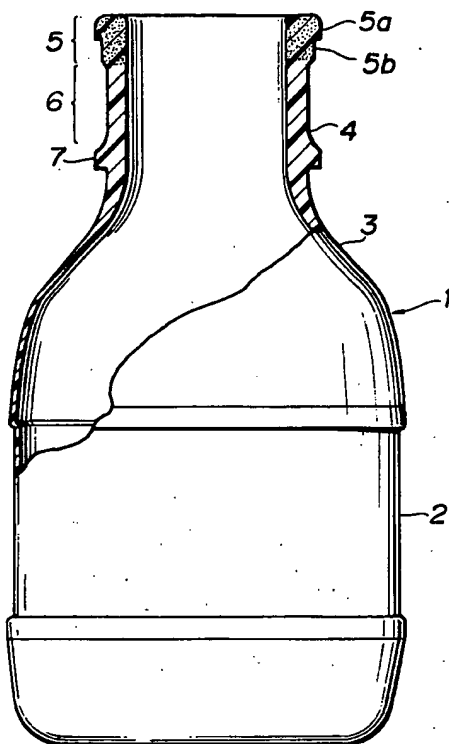
Primary Examiner—William Price
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Attorney, Agent, or Firm—Parkhurst & Oliff

[57] **ABSTRACT**

A hollow, blow-molded container of a biaxially oriented saturated polyester resin in which the upper part of the neck section is formed thicker than the intermediate section, and the upper half part of the upper part is formed thicker than the lower half part of the upper part. Thus, a cap can be exactly mounted on the neck section of this container, and the quantity of the material of the neck section can be reduced.

5 Claims, 1 Drawing Figure





CONTAINER OF POLYETHYLENE TEREPHTHALATE OR SATURATED POLYESTER RESIN

CROSS-REFERENCE TO RELATED APPLICATION

This is a continuation of application Ser. No. 331,872 filed Dec. 17, 1981, now abandoned.

This application is related in part to pending application Ser. No. 413,560, filed Aug. 31, 1982, now abandoned.

BACKGROUND OF THE INVENTION

The present invention relates to a hollow blow-molded container of a biaxially oriented saturated polyester resin or polyethelane terephthalate.

Saturated polyester resin has a wide range of applications as the material of containers such as bottles and the like, because it has excellent physical properties such as gas barrier characteristics and so forth.

A conventional bottle-shaped container of the biaxially oriented saturated polyester resin can be strengthened by the biaxial orientation, can save the quantity of the material by the reduction in the thickness of the container due to the biaxial orientation, does not permit the escape of detrimental substance such as solvent or the like from the container, and does not produce toxic gas when it is incinerated after its disposal. Such bottle-shaped containers are formed, due to the convenience of molding, thin at only the neck section and thick at the shoulder, body and bottom sections according to the biaxial orientation. During biaxial orientation blow molding, the thermal deformation temperature is extremely low. When high temperature liquid is, for example, filled in the container for heat-sterilization, the container is thermally shrunken making it impossible to fill the container accurately. Therefore, it is necessary to be subject the container to heat treatment simultaneously with or after its formation so as to enhance the thermal deformation temperature of the biaxially oriented sections of the container. It is also necessary to carry out the heat treatment to prevent a deterioration of the dimensional accuracy caused by high temperature, to prevent the occurrence of chatter, and to improve the capping accuracy by increasing the surface hardness, so as to strengthen the thick neck section of the container which is not biaxially oriented. Because the neck section of the conventional container is not biaxially oriented during blow molding, the resultant container has unstable physical properties and is susceptible to thermal deformation. However, containers, such as bottle-shaped containers, maybe required to be very tightly sealed because of the contents to be contained therein. Therefore, the neck section or end of such container is usually sealed or caulked by either a crown cap or a cap placed thereon with interposition of a packing. However, if the neck section is deformed by an external factor such as heat, the aforementioned sealing effect of the sealing means is diminished.

The conventional container of the polyethylene terephthalate resin is normally heat treated, after it is blow-molded by so-called thermal setting at a temperature exceeding the softening point of the polyethylene terephthalate resin so as to improve the thermal resistance thereof. Although the container body is subject to small thermal deformation, the neck section of the container

will not be affected even by a small deformation due to the reasons described above.

The polyethylene terephthalate resin has another important feature in its transparency. The physical properties and qualities of the contents sometimes deteriorate due to external light, depending on their properties and hence the container may need to impart resistance against external light.

SUMMARY OF THE INVENTION

Accordingly, an object of the invention is to provide a hollow, blow-molded container of a biaxially oriented polyethylene terephthalate or saturated polyester resin, in which the thick neck section can be efficiently and effectively heat treated, the material of the neck section can be reduced, and the neck section's heat treated state will be evident from its excellent colored outlook.

Another object of the invention is to provide a hollow, blow-molded container of a biaxially oriented polyethylene terephthalate or saturated polyester resin, in which the upper end of the neck section is thickly strengthened and the lower half of the upper end of the neck section is thinly formed to reduce the quantity of the material used therein.

Still another object of the invention is to provide a hollow, blow-molded container of a biaxially oriented polyethylene terephthalate or saturated polyester resin, in which the upper part of the neck section is increased in diameter larger than the intermediate part thereof, and the upper half of the upper part thereof is increased in diameter larger than the lower half part of the upper part thereof so as to provide an exact mounting for a cap.

Still another object of the invention is to provide a hollow, blow-molded container of a biaxially oriented polyethylene terephthalate or saturated polyester resin, in which the upper part of the neck section is crystallized on the surface to secure the exact tightening of the cap, and the crystallized part can be recognized, by its excellent color, as the crystallized biaxial orientation bottle-shaped container which is a different color from the non-crystallized part so as to enhance the value of the container as a commodity.

Still another object of the present invention is to provide a hollow, blow-molded container of a biaxially oriented polyethylene terephthalate or saturated polyester resin, in which all the aforementioned disadvantages of the conventional container can be eliminated and in which the container's resistance against external light is improved.

Still another object of the present invention is to provide a hollow, blow-molded container of a biaxially oriented polyethylene terephthalate or saturated polyester resin, in which the neck section thereof is rigidly formed having stable physical properties.

A further object of the present invention is to provide a hollow, blow-molded container of a biaxially oriented polyethylene terephthalate or saturated polyester resin, in which light from the exterior can be effectively shielded to improve the container's resistance thereto.

Yet another object of the present invention is to provide a hollow, blow-molded container of a biaxially oriented polyethylene terephthalate or saturated polyester resin, in which the neck section is not thermally affected nor deformed.

Still another object of the present invention is to provide a hollow, blow-molded container of a biaxially oriented polyethylene terephthalate or saturated poly-

ester resin, in which the neck section is not varied in size.

Still another object of the invention is to provide a hollow, blow-molded container of a biaxially oriented polyethylene terephthalate or saturated polyester resin, in which the thick neck section is colored densely as compared with the other such as body, shoulder and bottom, sections with preferably contrast in external appearance such that another article appears to be mounted on the top thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other related objects and features of the invention will be apparent from the following description of the disclosure found in the accompanying drawings and the novelty thereof pointed out in the appended claims.

FIG. 1 is an elevational side view, partly in cross section, of a preferred embodiment of the container of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1, which shows a preferred embodiment of the hollow, blow-molded bottle-shaped container of a biaxially oriented saturated polyester resin, a bottle-shaped container 1 of saturated polyester resin, a body 2, a neck section 4, and a shoulder 3.

The neck section 4 of the container 1 is formed much thicker than the body 2 since the neck section of a preformed parison is held in a mold and high pressure air is blown into the parison while longitudinally and biaxially orienting the parison into the blow-molded bottle-shaped container. The neck section of the parison, held by the mold, is not oriented, and hence becomes the thick neck section of the blow-molded bottle-shaped container.

The upper part 5 of the neck section 4 of the container 1 is so formed as to be thicker and larger in outer diameter than the intermediate section 6 of the neck section 4. The upper half part 5a of the upper part 5 is formed thicker and larger in outer diameter than the lower half part 5b of the upper part 5. It is preferable to provide a stepped-part between the upper half part and the lower half part as well as between the lower half part of the upper part and the intermediate part. It is noted that the thickness of the upper half part of the upper part is wide enough to provide the strength necessary for the capping of the neck section, the lower half part is not as thick as the upper half part of the upper part, and the intermediate part is not as thick as the lower half part of the upper part. It is preferable to form a reinforcing projecting strip 7 peripherally on the lower outer surface of the neck section of the container.

Then, the upper part and hence the upper half part and the lower half part thereof of the neck section of the container is crystallized. The crystallization is effectuated by heating the neck higher than a glass transition temperature and gradually cooling it. In order to mainly crystallize the upper part of the neck section of the container, a heat shielding plate may be wound on the neck section except for the upper part of the container the plate being removed after it is heated. The upper part of the neck section of the container is discolored due to the crystallization. When the bottle-shaped container is, for example, colorless and transparent, the crystallized part becomes white like milk, and when it is

colored and transparent, the crystallized part becomes opaque in the color of the container.

It should be understood from the foregoing description that since only the upper part of the neck section of the container is thickened and the upper half part of the upper part of the neck section is further thickened over the lower half part of the upper part thereof, the upper end of the neck section of the container is thickly strengthened and the lower half part of the upper end of the neck section is thinly formed to reduce the quantity of the material used therein. It should also be appreciated that since the upper half part of the neck section is larger in diameter than the lower half part of the upper part of the neck section the exact mounting of a cap can be secured to the bottle-shaped container. It should also be noted that since the upper part of the neck section of the container is crystallized on the surface, cap can be secured and precisely tightened to the bottle-shaped container. Because the crystallized part of the neck section of the container can be distinguished in its external appearance as the crystallized biaxial orientation bottle-shaped container due to the different color of the non-crystallized part of the neck section, the value of the container as a commodity can be enhanced. When the preformed piece is molded, a predetermined pigment is added to the material therefore so that the container body 1 when blow-molded is colored and transparent or opaque. The neck section 4 of the container 1 is crystallized by a heat treatment using the temperature control.

The container body 2 is colored and transparent or opaque as described above, so as to prevent the transmission of external light into the container 1 to improve the resistance of the container and to hence prevent the deterioration of the contents contained in the container 1.

The reason the neck section 4 of the container is crystallized is because the polyethylene terephthalate resin becomes physically and rigidly stabilized by the crystallization to resist thermal deformation, thus enabling the neck section 4 to be unaffected by the heat treatment which occurs when the container of the polyethylene terephthalate resin is blow-molded. When the preformed piece or parison is biaxially blow-molded, the neck section 4 is not oriented is therefore susceptible to crystallization and accordingly readily becomes brittle due to the crystallization, but since the neck section is thickened, it is firmly strengthened.

It should be understood from the foregoing description that since the container body of the polyethylene terephthalate resin is entirely colored, it can effectively shield light from the exterior to improve the container's resistance thereto. It should also be appreciated that since the neck section of the container is crystallized, it is not thermally affected nor deformed, and accordingly it is not anticipated that the neck section will be deformed or varied in size due to the high temperature created by either the thermal setting step for the entire container or the high temperature of a content liquid such as juice or milk which is filled within the container to be heat sterilized. It should also be noted that since the neck section of the container is rigidly treated, it can be conveniently caulked with a crown cap and effectively maintain the dimensional accuracy thereof.

It should also be appreciated that since the neck section of the container is crystallized and thickened, it is densely colored as compared with the other sections such as body, shoulder and bottom with preferably

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contrast in the external appearance such that another article appears to be mounted decoratively on the top thereof.

It should also be noted that since the container of the polyethylene terephthalate resin, constructed according to the present invention, is colored and transparent or opaque, it has excellent light resistance, and because the neck section of the container is crystallized, it is rigid and not susceptible to thermal deformation.

What is claimed is:

1. A hollow blow-molded container of polyethylene terephthalate resin comprising:

(a) a biaxially oriented and uncrystallized body section; and

(b) a neck section comprising an upper part and an intermediate part, said upper part comprising an upper half part and a lower half part, said intermediate part being adjacent to an upper end of said body section, said upper half part being larger in diameter and of a greater wall thickness than said lower half part, a stepped part being formed between said upper half part and said lower half part,

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said lower half part being larger in diameter and of greater wall thickness than said intermediate part, a stepped part being formed between said lower half part and said intermediate part, said intermediate part being adjacent to and of greater wall thickness than said body section, said upper half part and said lower half part being crystallized, and said intermediate part being uncrystallized.

2. A hollow blow-molded container of polyethylene terephthalate resin according to claim 1 wherein said body section and said neck section comprise a colored pigment for increasing the resistance of said container to outside light.

3. A hollow blow-molded container of polyethylene terephthalate resin according to claim 2 wherein said body section is substantially opaque.

4. A hollow blow-molded container of polyethylene terephthalate resin according to claim 2 wherein said body section is transparent.

5. The hollow blow-molded container of claim 1 wherein said container body section is thermally set.

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